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PG&E Letter DCL-03-151

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
90-Day Response to NRC Bulletin 2003-02, "Leakage From Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

Dear Commissioners and Staff:

Enclosed is the 90-day response for Diablo Canyon Power Plant Units 1 and 2 to NRC Bulletin 2003-02, "Leakage From Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity."

NRC Bulletin 2003-02 was issued on August 21, 2003, to advise pressurized water reactor (PWR) addressees that current methods of inspecting the reactor pressure vessel (RPV) lower heads may need to be supplemented with additional measures (e.g., bare-metal visual inspections) to detect reactor coolant pressure boundary leakage.

The bulletin requested information from all PWR addressees concerning inspections that have been or will be performed to verify the integrity of the RPV lower head penetrations, and required that they provide a written response to the NRC in accordance with the provisions of 10 CFR 50.54(f).

If you have questions regarding this response, please contact Mr. Stan Ketelsen at (805) 545-4720.

Sincerely,

Lawrence F. Womack

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mjr/4557
Enclosures
cc: Edgar Bailey, DHS
Bruce S. Mallett
David L. Proulx
Diablo Distribution
cc/enc: Girija S. Shukla

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of PACIFIC GAS AND ELECTRIC COMPANY	)	Docket No. 50-275 Facility Operating License No. DPR-80
Diablo Canyon Power Plant Units 1 and 2	)	Docket No. 50-323 Facility Operating License No. DPR-82

AFFIDAVIT

Lawrence F. Womack, being of lawful age, first being duly sworn upon oath says that he is Vice President – Nuclear Services of Pacific Gas and Electric Company; that he has executed this response to NRC Bulletin 2003-02 on behalf of said company with full power and authority to do so; that he is familiar with the content thereof; and that the facts stated therein are true and correct to the best of his knowledge, information, and belief.

Lawrence F. Womack
Vice President – Nuclear Services

Subscribed and sworn to before me this 18th day of November 2003.

Notary Public
County of San Luis Obispo
State of California

CHUCK MACKEY
Commission # 1397547
Notary Public - California
San Luis Obispo County
My Comm. Expires Feb 1, 2007

90-Day Response to NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

On August 21, 2003, the Nuclear Regulatory Commission (NRC) issued Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The NRC requested the following:

NRC Request 1:

All subject PWR addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

PG&E Response:

Since PG&E does not have a refueling outage scheduled before December 31, 2003, PG&E is providing this response within 90 days.

NRC Request 1(a):

A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include

- *when the inspections were performed,*
- *the extent of the inspections with respect to the areas and penetrations inspected,*
- *inspection methods used,*
- *the process used to resolve the source of findings of any boric acid deposits,*
- *the quality of the documentation of the inspections (e.g., written report, video record, photographs)*
- *and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.*

PG&E Response:

As identified in PG&E Letter DCL-03-008, "Response to NRC Request for Additional Information Regarding NRC Bulletin 2002-01, 'Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity'," PG&E's boric acid leakage inspection program, as applicable to inspections of the reactor vessel lower head, is implemented by the following procedures: AD4.ID2, "Plant Leakage Evaluation;" Surveillance Test Procedure (STP) R-8A,

"Reactor Coolant System Leakage Test;" STP R-8C, "Containment Walkdown for Evidence of Boric Acid Leakage;" and ER1.ID2, "Boric Acid Corrosion Control Program."

Procedures AD4.ID2 and STP R-8C implement commitments made in response to NRC Generic Letter (GL) 88-05.

AD4.ID2 is an administrative procedure that provides a standardized method for reporting and tracking leakage from plant systems. AD4.ID2 provides guidance on what actions must be taken if plant leakage is discovered. In addition, AD4.ID2 contains instructions on what to do if boric acid is found, including determining the source of a leak, preserving evidence, evaluating for wastage, and long-term corrective actions to control boric acid and prevent recurrence of problems. AD4.ID2 requires that any individual who discovers a leaking component identify and document the problem in accordance with the Diablo Canyon Power Plant (DCPP) problem identification and resolution procedure.

ER1.ID2 is the governing procedure for the boric acid corrosion control program, which addresses boric acid corrosion concerns associated with the reactor coolant pressure boundary (RCPB) and other primary systems containing boric acid. ER1.ID2 contains specific instructions regarding investigating and evaluating boric acid leakage on ASME Code class 1 components. ER1.ID2 is used in conjunction with other procedures that inspect for and respond to boric acid leakage.

STP R-8A is the system leakage test for the Class 1 pressure boundary required by ASME Code, Section XI. The 1989 edition of the Code requires, as a minimum, visual inspection of all mechanical joints that have been opened and closed since the last performance of the test. All accessible Class 1 components within the RCPB are required to be inspected during the 10-year system pressure/hydrostatic test. STP R-8A is performed following the normal heat up and pressurization of the primary system at normal operating pressure and temperature following refueling outages. The practice at DCPP is to inspect all accessible portions of the RCPB. This inspection includes the RPV upper head with the insulation installed. Any leaks of boric acid observed during the course of the walkdown, whether or not from the test boundary, are recorded, and the source and amount of leakage is determined. An evaluation is performed to determine the impact of that leakage on any Class 1 carbon steel components or supports that may be subject to corrosion. The STP R-8A inspections have not covered the lower RPV head.

STP R-8C is the containment walkdown procedure performed during each refueling outage when the reactor coolant system (RCS) is depressurized. It is used to identify boric acid leakage from any source inside containment to minimize potential boric acid corrosion of Class 1 low alloy/carbon steel RCPB

components, including supports. It is also used to perform examinations of the control rod drive mechanism (CRDM) area above the RPV head insulation. STP R-8C is also used during forced outages.

Previously Performed RPV Lower Head Inspections

Previous STP R-8C inspections performed on the RPV lower head without insulation removal during Unit 2 Refueling Outage 10 (2R10) and Unit 1 Refueling Outage 11 (1R11) did not identify any boric acid leakage or corrosion.

In response to Question 5 in PG&E Letter DCL-03-008, PG&E committed to remove insulation sufficient to permit inspection, and inspect the surface of the lower reactor vessel to identify leakage or corrosion once per three refueling outages, beginning in Unit 2 Refueling Outage 11 (2R11) and Unit 1 Refueling Outage 12 (1R12). This schedule is consistent with NRC Bulletin 2002-02 given the cold leg temperatures at DCPP.

As committed in DCL-03-008, PG&E performed a bare-metal visual inspection of the RPV lower head during 2R11 in February 2003. The 2R11 boric acid inspection of the RPV lower head was conducted by removing insulation panels on the flat bottom portion of the insulation shell. DCPP's certified VT-2 examiners conducted a direct visual examination with portable lighting from several vantage points through insulation panel removals. All the examiners involved had participated in top head robotic examinations and had received training on industry experience with boric acid leakage from reactor vessel closure heads, which included a review of photographs and descriptions of leakage at other plants.

All 58 bottom mounted instrumentation (BMI) tube penetrations and surrounding areas were inspected for any signs of boric acid accumulation. Although not documented with video recording equipment, the examination effectively covered the circumference of all BMI's and the bottom head base metal. Documentation consisted of photographs of the bottom head general areas, with particular attention to boric acid trails to allow comparison with future examination results. If examination had identified leakage, the procedure in use (STP R-8C) would have required immediate reporting in accordance with OM7.ID1, "Problem Identification and Resolution - Action Request" and evaluation in accordance with AD4.ID2, "Plant Leakage Evaluation."

No traces of boric acid were seen emanating from any of the BMI/bottom head annuli. Some thin-film boric acid trails determined to have come from historical cavity seal leakage were noted to have run down onto the bottom head. These deposits were characterized by the Level III VT-2 examiners as not having originated from, nor masked at-pressure leakage from any of the BMI tube penetrations. This conclusion was based on attributes such as: evidence of

deposition by flow trails from above the lower reactor head, no evidence of three dimensional buildup, greater concentrations away from the BMI tube and weld buildup vs. on the BMI tube or buildup, no deformation or displacement of the film deposits at the BMI juncture as would happen if a leak source occurred under the film, no difference in color indicating different aging, and none of the distinctive "popcorn" appearance previously seen in leaks at other plants. Similar small thin-film boric acid deposits attributed to known previous leakage from the cavity seal were evident on the surrounding concrete vessel support structure and on the outside of the reactor vessel insulation.

Compliance with Applicable Regulatory Requirements

The DCPP Unit 2 inspection of the lower reactor vessel head demonstrated that the applicable regulatory requirements are satisfied because there was no evidence indicating any pressure boundary leakage from the reactor vessel bottom head, nor was there any evidence of corrosion or wastage.

PG&E has previously evaluated compliance with regulatory requirements. The previous conclusions were reviewed and PG&E has concluded that DCPP continues to satisfy all applicable regulatory requirements. Refer to PG&E Letter DCL-02-063, "60-Day Response to NRC Bulletin 2002-01, 'Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity,'" dated May 17, and PG&E Letter DCL-03-008, "Response to NRC Request for Additional Information Regarding NRC Bulletin 2002-01, 'Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity,'" dated January 31, 2003, for a discussion of compliance with regulatory requirements.

As described in the applicable regulatory requirements section of Bulletin 2003-02, several provisions of the NRC regulations pertain to the issue of reactor head degradation and reactor pressure vessel head (RPVH) BMI cracking.

The applicable regulatory requirements are as follows:

- Appendix A of 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants"
  - GDC 14 - "Reactor Coolant Pressure Boundary"
  - GDC 31 - "Fracture Prevention of Reactor Coolant Pressure Boundary"
  - GDC 32 - "Inspection of Reactor Coolant Pressure Boundary"
- Plant Technical Specifications
- 10 CFR 50.55a, Codes and Standards, which incorporates by reference Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code"

- Appendix B of 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criteria V, IX, and XVI
- NRC Generic Letter 88-05

PG&E has effectively implemented comprehensive inspection programs, which contain all inspections required by these regulations as well as those required by the ASME Code and DCPP's regulatory commitments. The basis for concluding that all regulatory requirements are being met at DCPP is provided below:

General Design Criteria (GDC)

GDC 14 specifies that the RCPB be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. GDC 31 specifies that the probability of a rapidly propagating fracture of the RCPB be minimized. GDC 32 specifies that components that are part of the RCPB have the capability of being periodically inspected to assess their structural and leak-tight integrity; inspection practices that do not permit reliable detection of degradation are not consistent with this GDC. These requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 respectively, were satisfied during the initial design and licensing of DCPP and continue to be satisfied during operation.

In addition, Alloy 600 susceptibility to Primary Water Stress Corrosion Cracking (PWSCC) is an industry-recognized issue and is common to both the upper and lower reactor vessel head penetrations at DCPP. However, the upper head is exposed to higher temperatures, which increases the probability of experiencing PWSCC over that of the lower head. Recent examinations of the upper head nozzles of DCPP Units 1 and 2 and the lower head of Unit 2 have resulted in no detectable defects providing additional assurances that the applicable GDC are being met.

Plant Technical Specifications (TS)

The limits for DCPP RCPB leakage are provided in TS 3.4.13, "RCS OPERATIONAL Leakage," and are stated in terms of the amount of leakage (i.e., 1 gallon per minute for unidentified leakage; 10 gpm for identified leakage; and no leakage in the RCS pressure boundary). Routine surveillance testing is required to ensure these requirements are met.

Based on industry experience, most leaks from RCS Alloy 600 penetrations have been well below the sensitivity of on-line leakage detection systems. However, if leakage or unacceptable indications are identified, defects will be identified and repaired before startup. If

measurable leakage is detected by the on-line leak detection systems, the leak will be evaluated per the TS, and the plant will be shut down if required. Upon detection and identification of a RCPB leak, corrective actions will be taken to restore RCPB integrity. DCPP continues to meet the requirements of this TS.

Inspection Requirements (10 CFR 50.55a and ASME Section XI)

NRC regulations in 10 CFR 50.55a require that the RCPB meet the requirements of Section XI of the ASME Boiler and Pressure Vessel Code. Section XI requires inspection and corrective actions for RCPB degradation. PG&E complies with these requirements through the implementation of the DCPP Inservice Inspection Program. Therefore, the Section XI requirements continue to be met.

Quality Assurance Requirements (10 CFR 50, Appendix B)

Criterion V states in part that activities affecting quality shall be prescribed by and accomplished in accordance with documented instructions that provide appropriate acceptance criteria. DCPP uses procedure STP R-8A and ISI VT 2-1, "Visual Examination during Section XI System Pressure Test," which contain acceptance criteria based on the ASME Code. ISI VT 2-1 also contains personnel qualification and record keeping requirements.

Criterion IX states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements. Procedure ISI VT 2-1 requires personnel to be qualified and certified to at least Level II in the VT-2 method to perform examinations and to interpret test results.

Criterion XVI of Appendix B states that measures shall be established to assure those conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions. At DCPP, if any indication of leakage is detected during the inspections described in this response, corrective actions are required to be taken in accordance with the corrective action program and plant procedures. Any detectable degradation of the RCPB considered to be a significant condition adverse to quality would require appropriate actions to be taken, including a root cause analysis. In consideration of potential conditions adverse to quality relating to RCPB leakage, PG&E has been actively participating in industry organizations (Westinghouse Owners Group and EPRI Material

Reliability Program) and continues to be aware of industry experience. PG&E continues to meet the requirements of 10 CFR 50, Appendix B.

NRC Generic Letter 88-05

PG&E has implemented the inspection and walkdown requirements of Generic Letter 88-05. To be consistent with the inspection of other leak sites subject to cold leg (or near cold leg) temperatures, the DCPP Boric Acid Corrosion Prevention Program has been revised to include the bottom of the reactor vessel as a potential leak site.

PG&E has also concluded that the discussion in EPRI report 1006284, titled "PWR Materials Reliability Program Response to NRC Bulletin 2001-01 (MRP-48)," dated August 2001 remains a valid discussion of compliance with regulatory requirements.

NRC Request 1(b):

A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include

- *the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected,*
- *inspection methods to be used, qualification standards for the inspection methods,*
- *the process used to resolve the source of findings of boric acid deposits or corrosion,*
- *the inspection documentation to be generated,*
- *and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations*

PG&E Response:

PG&E's boric acid leakage inspection program with respect to the RPV lower head is described above in the response to NRC Request 1(a).

In addition to the system leakage test requirements of the 1989 edition of ASME Section XI, PG&E will include the lower RPV head area in the system leakage test (STP R-8A). This inspection will be performed with the insulation in place and the RCS pressurized.

The examination scope for the next DCPP Unit 1 and Unit 2 refueling outages will include all 58 BMI penetrations, including 100 percent of the circumference of

each penetration as it enters the RV lower head, and the areas surrounding the tubes. The insulation package on Unit 1 conforms to the shape of the bottom head. Small clearances to the reactor vessel pose a challenge to direct examination. A design change to the to the Unit 1 insulation is planned for 1R12, scheduled to start in March 2004 to lower the bottom insulation to provide added access space. This will provide for either direct visual or remote visual examination of 360° of all lower reactor vessel head penetrations.

DCPP Unit 2 does not require a modification to the insulation to facilitate bare-metal visual inspections.

Subsequent refueling outages in Unit 1 and Unit 2 will repeat the visual examination of all 58 BMI penetrations, including 100 percent of the circumference of each penetration as it enters the RV lower head, and the areas surrounding the tubes every third outage consistent with the commitment in PG&E Letter DCL-03-008. This schedule is consistent with NRC Bulletin 2002-02 recommended upper head inspections given the cold leg temperatures at DCPP. This frequency will continue until such time that industry experience or regulatory guidance indicates a modification of the inspection frequency or method is warranted.

STP R-8C and STP R-8A require that persons performing boric acid inspections be VT-2 certified. Inspection methods for both units will include visual examination by VT-2 examiners certified in accordance with ASME Section XI requirements. The visual examination may include optical aids such as high-resolution cameras, magnifying optics and robotic delivery systems. Such systems will be qualified as providing adequate visual resolution as required by ASME Code Section XI 1989 Edition rules.

Supplemental information may be gathered as necessary to assist in resolution of any findings, such as sample acquisition and isotopic analysis. Continued awareness by the inspection staff of industry events related to BMI issues will assure that the resolution of findings relies on certified individuals whose knowledge base and examination procedures incorporate recent information relevant to the examination task.

Inspection documentation will be in accordance with VT-2 examination procedure requirements of the ASME Section XI code. A data sheet will document the examination and locations with relevant indications will be photo or video documented to assist in analysis and disposition as needed.

The basis for concluding that DCPP will continue to satisfy the applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations for DCPP Units 1 and 2 is provided in the response to NRC Request 1(a). PG&E will continue to meet these requirements.

NRC Request 1(c):

If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

PG&E Response:

As stated in the response to NRC Request 1(b) above, PG&E will perform a bare-metal visual inspection of the RPV lower head during the next refueling outage and every third refueling outage thereafter until such time that industry experience or regulatory guidance indicates a modification of the inspection frequency or method is warranted.

PG&E is also planning to implement a design change to the DCPP Unit 1 RPV lower head insulation design during refueling outage 1R12 to facilitate bare-metal visual inspections of all 58 BMI penetrations. DCPP Unit 2 does not require a design change.

NRC Request 1(d):

If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

PG&E Response:

As stated in the response to NRC Request 1(b) above, PG&E will perform a bare-metal visual inspection of the RPV lower head during the next refueling outage and every third refueling outage thereafter until such time that industry experience or regulatory guidance indicates a modification of the inspection frequency or method is warranted.

NRC Request 2:
Within 60 days of plant restart following the next inspection of the RPV lower head penetrations, the subject PWR addressees should submit to the NRC a

summary of the inspections performed, the extent of the inspections, the methods used, a description of the as-found condition of the lower head, any findings of relevant indications of through-wall leakage, and a summary of the disposition of any findings of boric acid deposits and any corrective actions taken as a result of indications found:

PG&E Response:

PG&E will provide the requested information within 60 days after plant restart following the next inspection of the RPV lower head penetrations for DCPP Units 1 and 2.